CLAIMS

What is claimed is:

1. An apparatus, comprising:

a reactant gas accumulator in fluid communication with a reactant gas manifold of a fuel cell.

2. The apparatus of claim 1, further comprising:

a reactant gas source in selective fluid communication with an inlet manifold of the fuel cell, wherein the inlet manifold and an outlet manifold are in fluid communication.

3. The apparatus of claim 2, wherein the inlet manifold and an outlet manifold are in fluid communication across an electrode of the fuel cell.

4. The apparatus of claim 2, further comprising:

a pressure regulator disposed between the reactant gas source and the inlet manifold.

5. The apparatus of claim 2, further comprising:

a pressure controller disposed between the reactant gas source and the inlet manifold, wherein the pressure controller is capable of varying the velocity of the reactant gas provided to the inlet manifold.

6. The apparatus of claim 2, further comprising:

a control valve disposed between the reactant gas source and the inlet manifold.

7. The apparatus of claim 6, wherein the valve is selected from a solenoid valve, pneumatically driven valve, a pilot operated valve, and a motor driven valve.

8. The apparatus of claim 2, further comprising:

a flow control valve disposed between the reactant gas source and the inlet manifold to control the flow rate of the reactant gas.

9. The apparatus of claim 1, further comprising:

a sensor capable of measuring an operating condition or parameter of the system.

10. The apparatus of claim 9, wherein the sensor measures pressure within the accumulator.

11. The apparatus of claim 9, wherein the sensor measures the flow rate of the reactant gas through the fuel cell.

12. The apparatus of claim 9, wherein the sensor measures the voltage of the fuel cell.

13. The apparatus of claim 9, wherein the sensor measures the state of fuel cell membrane hydration.

14. The apparatus of claim 9, wherein the sensor measures the liquid water presence in the fuel cell.

15. The apparatus of claim 9, wherein the sensor measures the humidity of the reactant gases within the fuel cell.

16. The apparatus of claim 1, further comprising:

a pressure sensor disposed in the accumulator.

17. The apparatus of claim 16 wherein the apparatus is provided with a means for determining the rate of pressure change within the accumulator.

18. The apparatus of claim 1 further including a pressure switch disposed in the accumulator.

19. The apparatus of claim 6, further comprising:

a controller in communication with the control valve, wherein the controller instructs the valve to provide the selective communication.

20. The apparatus of claim 19, wherein the controller provides a duty cycle wherein the control valve is open for a first time period and the control valve is closed for a second time period.

21. The apparatus of claim 19, wherein the controller provides a duty cycle based on one or more operating parameters of the system.

22. The apparatus of claim 1, further comprising:

a flow restriction device disposed in fluid communication between the reactant gas accumulator and the outlet manifold.

23. The apparatus of claim 2, further comprising:

a flow restriction device disposed in fluid communication at a position between the reactant gas source and the inlet manifold, between the reactant gas accumulator and the outlet manifold, or a combination thereof.

24. The apparatus of claim 1, wherein the reactant gas accumulator is also in fluid communication with an inlet manifold of the fuel cell.

25. The apparatus of claim 24, further comprising:

a first check valve allowing unidirectional flow from the reactant gas accumulator to the inlet manifold; and

a second check valve allowing unidirectional flow from the outlet manifold to the reactant gas accumulator.

26. The apparatus of claim 24, further comprising:

means for directing the reactant gas flow from the accumulator into the fuel cell in a direction selected from the same direction as the reactant gas flow from the reactant gas source into the fuel cell, the opposite direction as the reactant gas flow from the reactant gas source in the fuel cell, and combinations thereof.

27. The apparatus of claim 26, further comprising:

a valving arrangement positioned in the reactant gas conduits to alternate the direction of reactant gas flow into the fuel cell.

28. The apparatus of claim 27, wherein the valving arrangement is selected from a shuttle valve and a four-way flow reversing valve.

29. The apparatus of claim 26, further comprising:

means for alternating the direction of reactant gas flow into the fuel cell.

30. The apparatus of claim 1, wherein the accumulator includes a surplus water dump system.

31. The apparatus of claim 1, further comprising:

a valve controller in communication with a valve for providing the selective communication between the reactant gas source and the inlet manifold.

32. The apparatus of claim 31, wherein the valve controller includes a timer and operates the valve at specific time periods.

33. The apparatus of claim 2, wherein the pressure of the reactant gas to the fuel cell and the pressure of a second reactant gas source to the fuel cell are controlled to prevent a pressure differential that would damage the fuel cell.

34. The apparatus of claim 33, further comprising:

a second accumulator in fluid communication with a second reactant gas, wherein one of the reactant gas accumulators has a pressure regulator referenced to the pressure of the other reactant gas.

35. The apparatus of claim 2, further comprising:

an evacuation port in fluid communication with the accumulator for evacuating gas to remove inert species.

36. An apparatus, comprising:

a fuel cell having reactant gas distribution channels providing fluid communication between a reactant gas source and an accumulator vessel.

37. The apparatus of claim 36, wherein the reactant gas is selected from a fuel gas and an oxidant gas.

38. The apparatus of claim 36, further comprising:

a pressure regulator disposed between the reactant gas source and the reactant gas distribution system.

39. The apparatus of claim 36, further comprising:

a pressure controller disposed between the reactant gas source and the reactant gas distribution system, wherein the pressure controller is capable of varying the velocity of the reactant gas provided to the reactant gas distribution system.

40. The apparatus of claim 36, further comprising:

a control valve disposed between the reactant gas source and the reactant gas distribution system.

41. The apparatus of claim 36, further comprising:

a flow control valve disposed between the reactant gas source and the reactant gas distribution system to control the flow rate of the reactant gas in response to one or more parameter of the system.

42. The apparatus of claim 36, further comprising:

a sensor capable of measuring an operating condition selected from pressure within the accumulator, flow rate of the reactant gas through the fuel cell, voltage of the fuel cell, presence of liquid water in the fuel cell, reactant gas humidity, state of fuel cell membrane hydration, and combinations thereof.

43. The apparatus of claim 36, further comprising:

a pressure switch or sensor disposed in the accumulator.

44. The apparatus of claim 43, further comprising:

means for determining the rate of pressure change within the accumulator.

45. The apparatus of claim 40, further comprising:

a controller in communication with the solenoid valve, wherein the controller instructs the solenoid valve to provide selective fluid communication between the reactant gas source and the accumulator vessel.

46. The apparatus of claim 45, wherein the controller provides a duty cycle wherein the solenoid valve is open upon a first condition reaching a first setpoint and the solenoid valve is closed upon a second condition reaching a second setpoint.

47. The apparatus of claim 36, further comprising:

a flow restriction device disposed in fluid communication between the reactant gas accumulator and the reactant gas distribution system.

48. The apparatus of claim 36, further comprising:

a flow restriction device disposed in fluid communication at a position between the reactant gas source and the reactant gas distribution system, between the reactant gas distribution system and the reactant gas accumulator, or a combination thereof.

49. The apparatus of claim 36, wherein the reactant gas accumulator is in selective fluid communication with either an inlet end or outlet end of the reactant gas distribution system.

50. The apparatus of claim 49, further comprising:

a first check valve allowing only unidirectional flow from the reactant gas accumulator to the inlet end of the reactant gas distribution system; and

a second check valve allowing only unidirectional flow from the reactant gas distribution system to the reactant gas accumulator.

51. The apparatus of claim 49, further comprising:

means for directing the reactant gas flow from the accumulator to a water removal unit.

52. The apparatus of claim 49, further comprising:

means for directing the reactant gas flow from the accumulator into the fuel cell in a direction selected from the same direction as the reactant gas flow from the reactant gas source into the fuel cell, the opposite direction as the reactant gas flow from the reactant gas source in the fuel cell, and combinations thereof.

53. The apparatus of claim 51, further comprising:

shuttle valves positioned in communication with the inlet end and outlet end of the reactant gas distribution system to alternate the direction of reactant gas flow into the fuel cell.

54. The apparatus of claim 36, wherein the accumulator includes a surplus water removal system.

55. The apparatus of claim 36, further comprising:

a valve controller in communication with a valve for providing selective communication between the reactant gas source and the reactant gas distribution system.

56. The apparatus of claim 55, wherein the valve controller includes a timer and operates the valve at specific time periods.

57. The apparatus of claim 55, wherein the valve controller includes a pressure transducer and controls the rate of change of the pressure of the accumulator and fuel cell

58. The apparatus of claim 55, wherein the pressure of the reactant gas to the fuel cell and the pressure of a second reactant gas source to the fuel cell are controlled to prevent a pressure differential that would damage the fuel cell.

59. An apparatus, comprising:

an oxidant gas accumulator in fluid communication with an oxidant gas outlet manifold of a fuel cell; and

a fuel gas accumulator in fluid communication with a fuel gas outlet manifold of the fuel cell.

60. The apparatus of claim 59, wherein the oxidant gas comprises oxygen and the fuel gas comprises hydrogen.

61. The apparatus of claim 59, further comprising:

a pressure regulator disposed between an oxidant gas source and an oxidant gas inlet manifold; and

a pressure regulator disposed between a fuel gas source and a fuel gas inlet manifold.

62. A method, comprising:

purging water from a fuel cell with a reactant gas supply;

accumulating the reactant gas under pressure from the reactant gas supply; and

supplying the accumulated reactant gas to the fuel cell.

63. The method of claim 62, further comprising:

supplying the accumulated reactant gas to the fuel cell through an inlet manifold, an outlet manifold, or a combination thereof.

64. The method of claim 62, wherein the reactant gas is selected from an oxidant gas and a fuel gas.

65. The method of claim 62, further comprising:

accumulating a second reactant gas under pressure from a second reactant gas supply; and

supplying the accumulated second reactant gas to the fuel cell, wherein the reactant gases comprise an oxidant gas and a fuel gas.

66. The method of claim 62, further comprising:

regulating the pressure of the reactant gas.

67. The method of claim 62, further comprising:

regulating the flow rate of the reactant gas from the reactant gas supply.

68. The method of claim 62, further comprising:

receiving the purged water in the accumulator; and

removing the purges water from the accumulator.

69. The method of claim 62, further comprising:

repeating the steps of purging, accumulating and supplying.

70. The method of claim 69, wherein the steps of purging, accumulating and supplying are repeated under conditions selected from pressure within the accumulator, flow rate of the

reactant gas through the fuel cell, voltage of the fuel cell, state of fuel cell membrane hydration, and combinations thereof.

71. A method, comprising:

supplying a reactant gas through a fuel cell at a flow rate sufficient to remove water; and then

returning the reactant gas to the fuel cell.

72. The method of claim 71, further comprising:

periodically switching between the steps of supplying and returning.

73. The method of claim 72, wherein the steps are periodically switched according to a duty cycle.

74. An apparatus, comprising:

a reactant gas source in fluid communication with an inlet and an outlet of a fuel cell; and

a shuttle valve to change direction of the reactant gas flow into the fuel cell.